

Maritime AI, Machine Learning Research

National Academies, Marine Board Spring 2026 Meeting – Irvine, CA

Martha Grabowski

Professor of Practice
Dept of Industrial & Systems
Engineering

Email: marthagrabowski@gmail.com

Web: <https://faculty.rpi.edu/martha-rose-grabowski>

LinkedIn:
<https://www.linkedin.com/in/martha-grabowski-39966912>

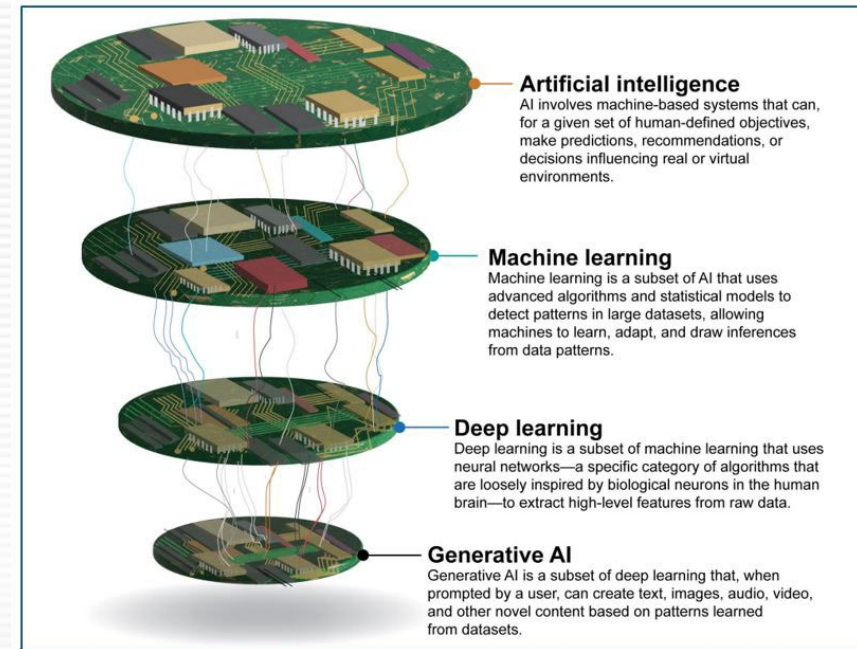
April 28, 2026



Rensselaer

Framing Questions

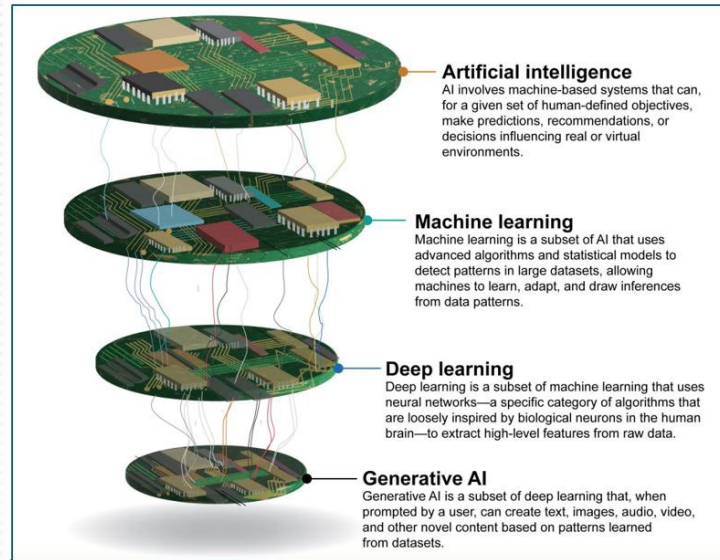
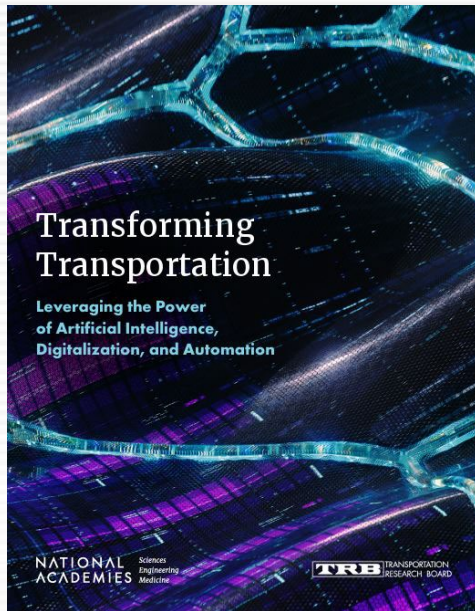
1. How are advanced data & analytics capabilities (AI, ML, LLMs) currently supporting financial & operational decision-making across the MTS?
- What future initiatives are under consideration?
2. What is the outlook for public- and private- sector data convergence to enable comprehensive dashboards, trend analysis & early warning systems to support infrastructure coordination and supply chain resilience?



Rolls Royce, Autonomous Ship, IMO, 20 April 2026

<https://www.imo.org/en/mediacentre/hottopics/pages/autonomous-shipping.aspx>, retrieved 20 April 2026

Context



Artificial Intelligence ✓

- Autonomy*
- Reasoning, Logic
- Image Recognition*
- Natural Language Processing*
- Voice Recognition
- Locomotion
- Emotion, Ethics
- Artificial General Intelligence

Machine Learning ✓

- Classification*
- Inspection*
- Pattern Recognition*
- Automated Learning*

Deep Learning ✓

- Automated learning*
- Neural Nets*
- Self-Healing Systems*
- Model Improvement*
- Human-Autonomy Teams*

Generative AI

- Large language models (LLMs)
- Image, text, audio, video, haptic generation
- Model Improvement

[1] GAO (2025). *Artificial Intelligence: Generative AI Use and Management at Federal Agencies*. GAO-25-107653, July.

[2] National Academies of Science, Engineering & Medicine (NASEM), Transportation Research Board (TRB) Executive Committee. (2026). *Transforming Transportation: Leveraging the Power of Artificial Intelligence, Digitalization and Advanced Autonomy*. Washington, DC: NASEM TRB Report A03983, April.

National Academies, Forum on Cyber Resilience. (2026). *Securing AI Systems: New Challenges & Research Priorities*. Washington, DC: NASEM workshop, 20-21 April.



Context

IMO Maritime Autonomous Surface Ship (MASS)

- Computer vision, Geofencing, Image & Pattern recognition
- Voice recognition, Natural Language Processing
- Sensor integration, management
- Automated navigation, weather routing, docking/undocking, cargo operations, voyage planning, safety monitoring & simulation, engine monitoring/operations/maintenance, customs/logistics planning
- *Sponsors:* EU, China, Maritime nations, Classification societies, Systems integrators, Defense contractors, Foundations, Utilities
- **No US commercial maritime demo project**



Rolls Royce, Autonomous Ship, IMO, 20 April 2026

Olympia Dream Seto, Nippon Foundation, MASS Level 4 Autonomous Electric Passenger Ferry, 9 Feb 2026;

<https://www.marineinsight.com/know-more/worlds-first-autonomous-passenger-ship-sailing-without-captain-or-crew/>, retrieved 21 Feb 2026



Context

IMO Maritime Autonomous Surface Ship (MASS)

- **MSC 109 (December 2024)** --Revised Road Map for MASS Code
- **May 2026** - Finalize and adopt non-mandatory MASS Code, MSC 111
- **December 2026** - Framework for an Experience-building phase (EBP) post adoption of the non-mandatory MASS Code
- **2028** – Mandatory MASS Code, based on the non-mandatory Code and results from the EBP and relevant sub-committees' reviews; Consider amendments to new SOLAS chapter SOLAS for the Code's adoption;
- **By 1 July 2030 at the latest** - Mandatory MASS Code, for entry into force on 1 Jan 2032.

<https://www.imo.org/en/mediacentre/hottopics/pages/autonomous-shipping.aspx>, retrieved 20 April 2026.



MTS AI/Machine Learning- Operational Decision Making

Risk Analysis [3, 4]

Traffic, vessel, water level, weather, pilot data...

NN → Messy Data → Self Healing Databases, Automated Data Anomaly Detection, Repair

--Lower Mississippi River Risk Analysis (2018-20)

--W Alaska Worst Case Discharge (2022-24)

Regulatory Impact -- 50-60% WCD% carried (11/25)

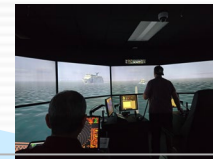
Alternative Planning Criteria +

Nav Decision Making [5, 6]

Staten Island Ferry – BRM Training (2022 -)

Alaska Chadûx Network – STARS (2026 -)

AI, ML – Watchstanding, BRM eval, ICS products



Human Autonomy Teams [7, 8]

SUNY Upstate Medical U, USCG W Alaska & US Arctic Remote Humanitarian & Medical medical, logistics deliveries

Visual Line of Sight – Beyond VLOS **Autonomy** (2022 - present)



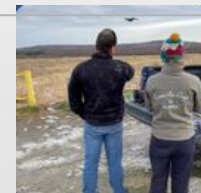
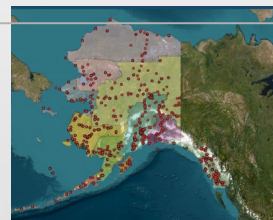
Arctic Bulk Fuel Facility Inspection

USCG W Alaska & US Arctic (2023 -)

ML: Inspect 343 Arctic BFFs – priority, weather, multi agency

Two stage stochastic – agency priorities, weather, hub & spoke

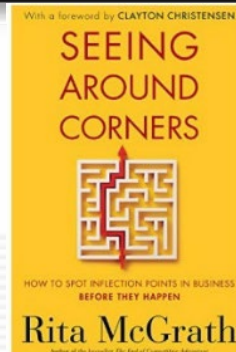
Next: **Integrate Drone image**, thermal, etc. data





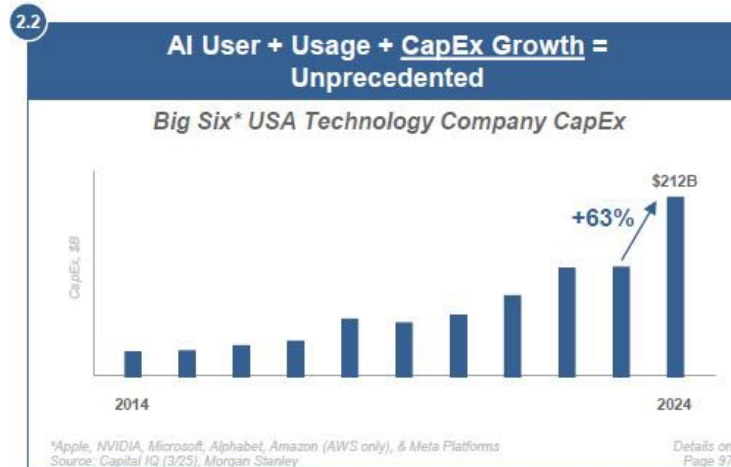
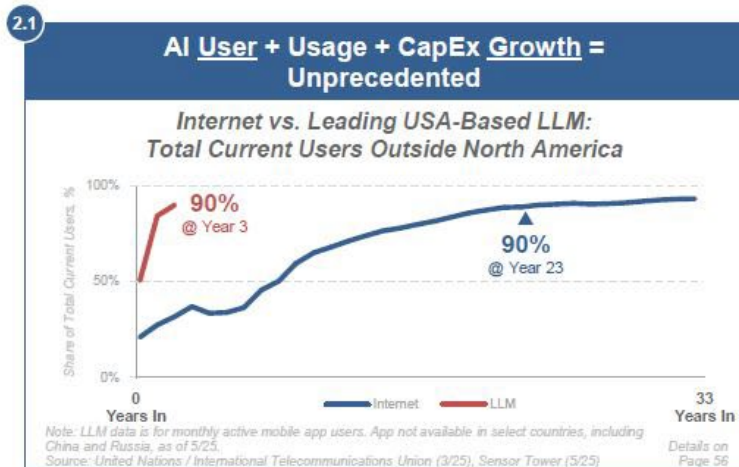
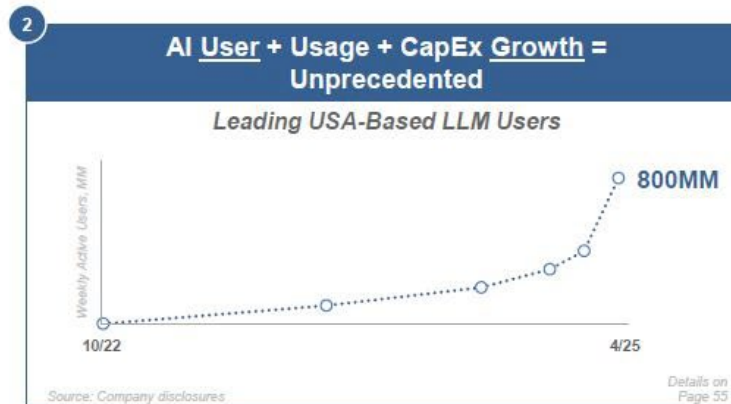
The hidden menace behind Big Tech's AI arms race: Meta, Amazon, and others are spending billions on hardware that's worthless in as little as 3 years, says Research Affiliates partner

Shawn Tully, *Fortune*, 15 April 2026



Mary Meeker, *Trends—Artificial Intelligence*, 30 May 2025

Future Initiatives





Implications

1. AI, ML, LLMs are here – **Data & Model Integration** are hurdles
Data Quality, Transparency, Integration are issues
2. **Timelines have shrunk/evaporated** – Ukraine, 'AI-Agile' Development
3. **Autonomous Teaming** is the Future of MTS supply chains
Hybrid teams -- the supervisors, nodes and partners are bots
3. **Workforce**
0-12 Curricular Refresh + Maritime Academies → Industry Refresh
5th Grade Pivot tables –Excel/Microsoft CoPilot
Certifications – credit/non, free, Google, MIT/EdX
Recruiting: Drone Clubs, UAS pilots, Video gamers, 4th/5th grade STEM
4. **Ethics** – *Guidelines, Best practices, Case studies – Big 6* defining use & practice***
5. **Needed:** Integrated RT platform, tests, at scale, vs. benchmarks, w/ policies, KPI's



References

- [1] GAO (2025). *Artificial Intelligence: Generative AI Use and Management at Federal Agencies*. GAO-25-107653, July.
- [2] National Academies of Science, Engineering & Medicine (NASEM), Transportation Research Board Executive Committee. (2026). *Transforming Transportation: Leveraging the Power of Artificial Intelligence, Digitalization and Advanced Autonomy*. Washington, DC: NASEM TRB Report A03983, April.
- [3] Dorsey, C., Wang, B., Grabowski, M.R., Merrick, J.R.W. & Harrald, J.R. 2020. Self-Healing Databases for Predictive Risk Analyses in Safety-Critical Systems. *Journal of Loss Prevention in the Process Industries*, 63, 104014.
- [4] McGarvey, J., Grabowski, M.R., Custard, B., & Gabelein, S. 2025. Self-Healing Databases for Emergency Response Logistics in Remote and Infrastructure Poor Settings. *Logistics*, 9, 23, February. <https://doi.org/10.3390/logistics9010023>
- [5] Rowen, A., Grabowski, M.R. & Rancy, J.-P. 2021. Moving and Improving in Safety-Critical Systems: Impacts of Head- Mounted Displays on Operator Mobility, Performance and Situation Awareness. *International Journal of Human-Computer Systems*, 150, June, 102606.
- [6] Rancy, J.-P. & Grabowski, M.R. 2026. Seeing through Immersion: Integrating Human Computer Interaction Design Experience with Nano-Internet of Things Visualization in Safety-Critical Systems *Hawaii International Conference on Systems Sciences*, Maui, Hawaii, 6-9 January 2026, 14 June 2025.
- [7] Morgan, G. & Grabowski, M.R. 2025. Human Machine Teaming in Mobile Miniaturized Aviation Logistics Systems in Safety-Critical Settings. *Journal of Safety & Sustainability*, 2, March, 22-31. <https://doi.org/10.1016/j.jsasus.2025.02.001>
- [8] Grabowski, M.R., Morgan, G., McGarvey, J., Roberts, S., Squire, B., Ibanez, S., Bringsford, S. & Rowen, A.T. 2025. Human-Machine Autonomy in Medical & Humanitarian Logistics in Remote and Infrastructure Poor Settings. *Drones*. 9, 841. <https://doi.org/10.3390/drones9120841>.